PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-304647

(43)Date of publication of application : 28.11.1997

(51)Int.Cl. G02B 6/293

(21)Application number : 08-143435

(22)Date of filing : 15.05.1996

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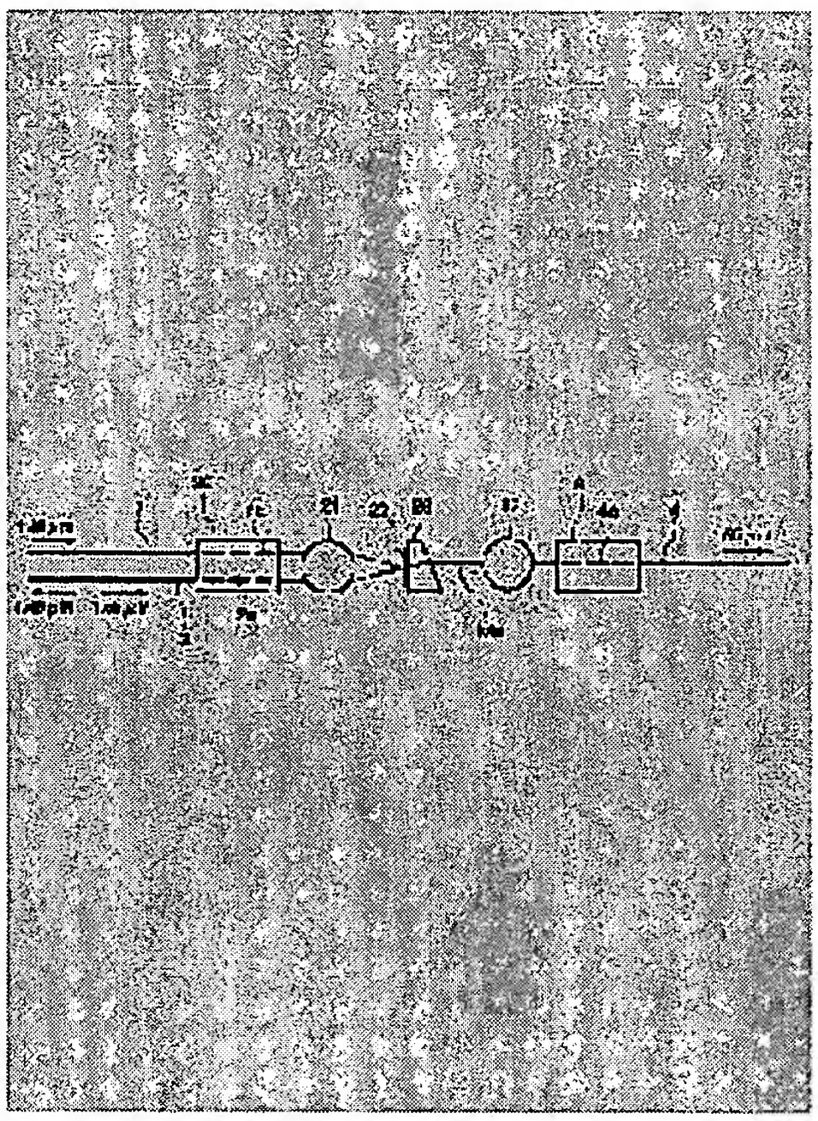
(54) OPTICAL CIRCUIT MODULE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an optical circuit module of easy-to-manufacture structure which is small in size and mounted in a small space.

SOLUTION: A double-core ferrule 20 which has two parallel coated optical fibers 2a and 7a and a single-core ferrule 9 which has one coated optical fiber 4a are arranged on one straight module main axis Ms almost coaxially with each other, and the tip surfaces of both the ferrules 20 and 9 face each other at a specific interval. A 1st collimator lens 21 which faces the tip surface of the double-core ferrule 20, a 2nd collimator lens 12 which faces the tip surface of the single-core ferrule 9, and an optical multiplexing demultiplexing filter 22 and a wedge glass plate 23 which are interposed between the 1st and 2nd collimator lenses 21 and 12 are arranged linearly on the module main axis Ms in the interval part between the tip surface of both the ferrules 20 and 9.



LEGAL STATUS

[Date of request for examination] 21.10.1997

[Date of sending the examiner's decision of rejection] 25.07.2000

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3162625
[Date of registration]	23.02.2001
[Number of appeal against examiner's decision of rejection]	2000-13422
[Date of requesting appeal against examiner's decision of rejection]	24.08.2000
[Date of extinction of right]	

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the optical circuit module which multiplexs two or more light from which it intervenes between 3 or four optical fibers, and wavelength differs especially about the optical circuit module used as components, such as an optic fiber communication system, or is separated spectrally.
[0002]
[Description of the Prior Art] In a certain kind of optic fiber communication system, the optical fiber amplifier of a configuration of being shown in drawing 1 is used as known well. As shown in this drawing, signal light with a wavelength of 1.55 micrometers introduced into input port Pin spreads to an erbium-doped optical fiber 2 through an optical isolator 1. The optical multiplexing branch circuit 3 is penetrated from an erbium-doped optical fiber 2, it spreads to an optical fiber 4, an optical isolator 5 is passed, and this signal light is output port Pout. It reaches.
[0003] On the other hand, the excitation light source 6 which consists of semiconductor laser generates excitation light with a wavelength of 1.48 micrometers. The excitation light spreads an optical fiber 7, is introduced into the optical multiplexing branch circuit 3, and spreads an erbium-doped optical fiber 2 from here to said signal light and opposite direction. The signal light (wavelength of 1.55 micrometers) which spreads an erbium-doped optical fiber 2 is amplified by the excitation light (wavelength of 1.48 micrometers) which advances to an opposite direction.
[0004] Thus, since the travelling direction of excitation light and the travelling direction of signal light are opposite, this type is called the optical fiber amplifier of a back excitation type. In addition, the optical fiber amplifier of the front excitation type which made the same the travelling direction of excitation light and signal light, and the optical fiber amplifier of the bidirectional excitation type which combined the back excitation type and the front excitation type are also well known from the former.
[0005] In the optical fiber amplifier of a back excitation type shown in drawing 1 , the aforementioned optical multiplexing branch circuit 3 was constituted, as shown in drawing 2 . The ferrule 8 to which this optical multiplexing branch circuit module connoted core wire 2a of said optical fiber 2, The ferrule 9 which connoted core wire 4a of said optical fiber 4, and the ferrule 10 which connoted core wire 7a of said optical fiber 7, It has the optical multiplexing spectral separation filter (called "WDM") 14 which intervenes between the opticals axis of the collimate lenses 11, 12, and 13 arranged on the optical axis of each ferrules 8, 9, and 10, respectively, and these three lenses.
[0006] Here, the optical multiplexing spectral separation filter 14 forms dielectric multilayers in a glass plate, and the following optical paths are formed of the optical physical relationship of this, three ferrules 8, 9, and 10, and collimate lenses 11, 12, and 13. The optical multiplexing spectral separation filter 14 is penetrated, it is condensed with a lens 12, and the signal light with a wavelength of 1.55 micrometers which carried out outgoing radiation from optical fiber core wire 2a of a multiplier system, and passed through the lens 11 is introduced into optical fiber core wire 4a of an output system. Moreover, it reflects with the optical multiplexing spectral separation filter 14, and is condensed with a lens 11, and the excitation light with a wavelength of 1.48 micrometers which carried out outgoing radiation from optical fiber core wire 7a, and passed through the lens 13 is introduced into optical fiber core wire 2a of a multiplier system.
[0007]
[Problem(s) to be Solved by the Invention] The above applications are one gestalt of the conventional technique set as the object of this invention. However, there was a problem that a miniaturization was difficult, by the conventional optical multiplexing branch circuit module of a configuration of having been shown in drawing 2 . While this module is attached in the form which penetrates the case which three ferrules 8, 9, and 10 are not illustrating and three collimate lenses 11, 12, and 13 are built in that case, the optical multiplexing spectral separation filter 14 is built in. And each optical fibers 2, 4, and 7 become the gestalt of being pulled out outside from said case.

[0008] Here, the ferrule 8 (optical fiber core wire 2a) and ferrule 9 (optical fiber core wire 4a) which carry out optical coupling on the transmitted light way of the optical multiplexing spectral separation filter 14 become the arrangement relation mostly located in a line on the same straight line like drawing 2 . On the other hand, the ferrule 8 (optical fiber core wire 2a) which carries out optical coupling on the reflected light way of the optical multiplexing spectral separation filter 14, and a ferrule 10 (optical fiber core wire 7a) make the include angle of 20 degrees - about 90 degrees to the axial gestalt which a ferrule 8 and a ferrule 9 make, and are attached in a case.
[0009] Therefore, a ferrule 10 will become the arrangement relation which protruded greatly in the side to the main shaft which the array of a ferrule 8 and a ferrule 9 makes. That is, it becomes the case gestalt from which a fiber 4 and a fiber 7 become Ha's character type. Moreover, since the collimate lens 11 for ferrule 8 and the collimate lens 13 for ferrule 10 are needed, respectively, the inside dimension of a case also becomes large. Therefore, the whole case is enlarged, an optical fiber 4 and an optical fiber 7 form Ha's character type, and will be attached, and a mounting tooth space also becomes large.
 [0010] Furthermore, as mentioned above, if it is going to equip with a ferrule aslant at an angle of predetermined, adjustment of the cross direction in alignment with the optical path for doubling a focal location and adjustment of an include angle will be needed, and its attachment and adjustment processing will become very complicated compared with what is arranged in parallel. That is, although adjustment between a ferrule 8 and 9 can be performed comparatively easily if it says in the example shown in drawing 2 , include-angle adjustment of the ferrule 10 with which it equips aslant becomes very complicated. And if an include angle etc. shifts, a desired property will no longer be acquired.
[0011] It is more small, and the mounting tooth space of the place which this invention was made in view of the above-mentioned background, and is made into the purpose is also small, it ends, can perform [the above-mentioned problem can be solved, and] attachment and assembly easily, and is to offer the optical circuit module which planned cost ** in the list in the ease of manufacturing by aiming at reduction of components mark.
[0012]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the optical circuit module of the 1st invention is a module of 3 port molds, and 2 heart ferrule which has two parallel optical fiber core wires as a fundamental module layout, and 1 heart ferrule which has one optical fiber core wire were mostly arranged by the same axle on the module main shaft which makes one straight line, the apical surface of both ferrules set predetermined spacing, and it has countered. Moreover, in the spacing part of the apical surface of said both ferrules, on said module main shaft, the 1st collimate lens which counters the apical surface of said 2 heart ferrule, the 2nd collimate lens which counters the apical surface of said 1 heart ferrule, and the optical multiplexing spectral separation filter and wedge plate (the gestalt of operation "wedge glass plate") which intervene between the 1st and 2nd collimate lenses arrange in serial, and are arranged. and it is **** about the optical arrangement relation in which the core wire of said 1 heart ferrule and one core wire of said 2 heart ferrule carry out optical coupling on the transmitted light way of said optical multiplexing spectral separation filter, and two core wires of said 2 heart ferrule carry out optical coupling on the reflected light way of said optical multiplexing spectral separation filter -- it is carrying out (claim 1).
[0013] The optical circuit module of the 2nd invention is a module of 4 port molds, and 1st 2 heart ferrule which has two parallel optical fiber core wires as a fundamental module layout, and 2nd 2 heart ferrule which similarly has two parallel optical fiber core wires were mostly arranged by the same axle on the module main shaft which makes one straight line, the apical surface of both ferrules set predetermined spacing, and it has countered. Moreover, in the spacing part of the apical surface of said both ferrules, on said module main shaft, the 1st collimate lens which counters the apical surface of 1st 2 heart ferrule, the 2nd collimate lens which counters the apical surface of 2nd 2 heart ferrule, and the optical multiplexing spectral separation filter and wedge plate which intervene between the 1st and 2nd collimate lenses arrange in serial, and are arranged. and it is **** about the optical arrangement relation in which one core wire of 1st 2 heart ferrule and one core wire of 2nd 2 heart ferrule carry out optical coupling on the transmitted light way of said optical multiplexing spectral separation filter, and two core

wires each of 1st and 2nd 2 heart ferrules carry out optical coupling on the reflected light way of said optical multiplexing spectral separation filter, respectively -- it is carrying out (claim 2).
[0014] Also in which configuration of the 1st and the 2nd invention, the dielectric multilayers as said optical multiplexing spectral separation filter can be formed in the front face of said wedge plate, and these can be unified (claim 3).
[0015] Here, it is called the optical multiplexing spectral separation filter said by this invention also with WDM (Wavelength Division Multiplexer/Demultiplexer), and the thing of the optic which compounds the light of different wavelength or is separated spectrally is meant. That is, the incidence of the light of some wavelength carries out from a terminal different, respectively to the function (a spectral-separation function) which outputs light to the terminal which discriminated from wavelength and was decided from the light containing the wavelength from which some differed, respectively, and the optical components which have the function of the method of one at least among the functions (multiplexing function) which carry out outgoing radiation from one terminal as a light containing such wavelength say. Therefore, although it is called an optical multiplexing spectral separation filter, it is the concept in which it is not restricted to the thing equipped with the multiplexing function and the spectral separation function, but what has only a spectral separation function includes only a multiplexing function.
[0016] Moreover, what bends the optical path of the passing light suitably is told to close outgoing radiation light from which the wedge plate (prism for bending an optical path) which are the components which constitute the important section of this invention consists of isotropic media, such as a glass plate, and each ferrule finally becomes a module shaft and parallel. And if its attention is paid only to a wedge plate, either the incident light to the wedge plate or outgoing radiation light will become a module main shaft and parallel in principle.
[0017] And in this invention, 1 heart ferrule and 2 heart ferrule become the arrangement relation mostly located in a line on the same straight line, and two 2 heart ferrules become the arrangement relation mostly located in a line on the same straight line also in the 2nd invention. Moreover, since two fiber core wires by which endocyst is carried out to 2 heart ferrule are approaching very much, it can respond with a common collimate lens to two core wires.
[0018] Although predetermined must open to the optical path of two light and an angle must be established in order to perform optical spectral separation in an optical multiplexing list, moreover, in this invention even if it arranges the ferrules which arrange the shaft of each core wire of 2 heart ferrule in the location shifted from the optical axis of a collimate lens on a straight line, when an include angle is in two optical paths by which close outgoing radiation is carried out from the 2 heart, an exchange-optical path will dissociate -- having -- **** of light, and a spectrum -- processing is performed.
[0019] And since the wedge plate was formed, the optical path of the light which passes through between both ferrules is bent at a proper include angle, and becomes a module main shaft and parallel, and the close outgoing radiation light to both ferrules becomes a module main shaft and parallel. That is, since a ferrule can be put on a module main shaft and parallel, the angle which both ferrules make becomes 0 times. That is, it will become parallel, even if it is arranged in the shape of same straight line or shifts. Therefore, in case a telescopic case is equipped with both ferrules, it can attach easily and an installation location and an include angle can be adjusted easily.
[0020]
[Embodiment of the Invention] As for the optical circuit module of this invention, it is natural that it is not what should interpret the main point of this invention restrictively based on some examples of it being applied to the optical circuit of various configurations of various purposes, and explaining below. Below, in order to explain the gestalt of operation of this invention plainly, as contrasted with the conventional configuration of module shown in drawing 2 , it explains focusing on the example equivalent to the optical multiplexing branch circuit 3 in the optical fiber amplifier of a back excitation type shown in drawing 1 .
[0021] It is the optical circuit module by the gestalt of operation of the 1st of this invention which is shown in drawing 3 . This is the module of 3 port molds, and 2 heart ferrule 20 which has two parallel optical fiber core wires 2a and 7a as a fundamental module layout, and 1 heart ferrule 9 which has one

optical fiber core wire 4a were mostly arranged by the same axle on the module main shaft Ms which makes one straight line, the apical surface of both the ferrules 20 and 9 set predetermined spacing, and it has countered.
[0022] Moreover, in the spacing part of the apical surface of said both ferrules 20 and 9, on said module main shaft Ms, the 1st collimate lens 21 which counters the apical surface of 2 heart ferrule 20, the 2nd collimate lens 12 which counters the apical surface of 1 heart ferrule 9, and the optical multiplexing spectral separation filter 22 and the wedge glass plate 23 which intervene between the 1st and 2nd collimate lenses 21 and 12 arrange in serial, and are arranged.
[0023] and it is **** about the optical arrangement relation in which core wire 4a of 1 heart ferrule 9 and one core wire 2a of 2 heart ferrule 20 carry out optical coupling on the transmitted light way of the optical multiplexing spectral separation filter 22, and two core wires 2a and 7a of 2 heart ferrule 20 carry out optical coupling on the reflected light way of the optical multiplexing spectral separation filter 22 -- it is carrying out.
[0024] In addition, in drawing 3 , one core wire 2a of 2 heart ferrule 20 is connected with the erbium-doped optical fiber 2 for magnification in drawing 1 , core wire 7a of another side of 2 heart ferrule 16 is connected with the optical fiber 7 of the excitation system in drawing 1 , and core wire 4a of 1 heart ferrule 9 is connected with the optical fiber 4 of the output system in drawing 1 .
[0025] The optical multiplexing spectral separation filter 22 forms dielectric multilayers in a glass plate, and the wedge glass plate 23 consists of a glass plate which makes the predetermined include angle a front flat surface and whose flesh-side flat surface are not parallel. The following optical paths are formed of the optical physical relationship of these optical multiplexing spectral separation filter 22 and the wedge glass plate 23, and 2 heart ferrule 20, 1 heart ferrule 9 and collimate lenses 21 and 12.
[0026] That is, the optical multiplexing spectral separation filter 22 is penetrated, and a travelling direction is bent only for a predetermined include angle with the wedge glass plate 23, it is condensed with a collimate lens 12, and the signal light with a wavelength of 1.55 micrometers which carried out outgoing radiation from optical fiber core wire 2a of a multiplier system, and passed through the collimate lens 21 is introduced into optical fiber core wire 4a of an output system. Moreover, it reflects with the optical multiplexing spectral separation filter 22, and is condensed with the same lens 21, and the excitation light with a wavelength of 1.48 micrometers which carried out outgoing radiation from optical fiber core wire 7a, and passed through the collimate lens 21 is introduced into optical fiber core wire 2a of a multiplier system.
[0027] Moreover, like drawing 3 , in 2 heart ferrule 20, collimate lens 21, optical multiplexing spectral separation filter 22, wedge glass plate 23, collimate lens 12, and 1 heart ferrule 9, on the module main shaft Ms which makes one straight line, almost is arranged in in the shape of same straight line, it is arranged, and the whole is built in one telescopic case (not shown) by this arrangement relation. While two optical fibers 2 and an optical fiber 7 are pulled out in parallel from the end section of the telescopic case, one optical fiber 4 is pulled out from the other end of a telescopic case.
[0028] Since it becomes such a module gestalt, compared with the module gestalt of the conventional configuration shown in drawing 2, the appearance configuration of a case serves as telescopic [simple], and can make a dimension small sharply conventionally. Moreover, since two optical fiber core wires 2a and 7a by which endocyst is carried out to 2 heart ferrule 20 are approaching very much, it can respond with the common collimate lens 21 to two optical fiber core wires 2a and 7a. This also contributes to the miniaturization of a module case.
[0029] The above-mentioned description that a module case becomes telescopic [simple] is having realized by having adopted the configuration which arranges the proper wedge glass plate 23 into the optical path which ties collimate lenses 21 and 12, and bends an optical path appropriately. By using appropriately the optical-path bending effectiveness of the wedge glass plate 23, on the module main shaft Ms which makes one straight line, each optic (2 heart ferrule 20, collimate lens 21, optical multiplexing spectral separation filter 22, wedge glass plate 23, collimate lens 12, and 1 heart ferrule 9) can almost be arranged in in the shape of same straight line, and can be arranged.
[0030] That is, as shown in drawing 4 , the refractive index of the wedge glass plate 23 is set to n, and

when the vertical angle which a configuration illustrates with piece trapezoidal shape is set with E, the relation of the incident angle theta 1 and the outgoing radiation angle theta 2 is shown in the following formula.

[0031]

[Equation 1]

$$\sin\theta 2 = n \cdot \sin\left(E + \sin^{-1}\left(\sin\theta 1 / n\right)\right)$$

Therefore, with the gestalt of this operation, each optic can be arranged [by setting up the vertical angle E so that it may be set to 2= 0] [almost] in the shape of same straight line on the above-mentioned outgoing radiation angle theta module main shaft Ms at the time of the include angle (theta 1) which inclines to the module main shaft Ms.

[0032] That a module case can be constituted in telescopic [simple] means that manufacture of a module case is easy, and the structure of attaching each optic (2 heart ferrule 20, collimate lens 21, optical multiplexing spectral separation filter 22, wedge glass plate 23, collimate lens 12, and 1 heart ferrule 9) in the case becomes easy, and the assembly of each part article and the activity of adjustment become easy. Therefore, according to this invention, a small and highly efficient optical circuit module can be mass-produced cheaply.

[0033] Drawing 5 shows the gestalt of operation of the 2nd of this invention. Unlike the gestalt of the 1st operation shown in drawing 3 , with the gestalt of this operation, the dielectric multilayers as said optical multiplexing spectral separation filter 22 are formed in the front face of said wedge glass plate 23 for optical-path bending.

[0034] Thereby, with the gestalt of the 1st operation, what was constituted from a plate of another member is unified as optical multiplexing spectral separation filter 22 and a wedge glass plate 23, and reduction of components mark can be performed by communalizing. Furthermore, since adjustment of the physical relationship between components becomes unnecessary 1 grouping, adjustment becomes easy. Therefore, with the gestalt of this operation, it contributes to the further modular miniaturization and improvement in assembly nature. In addition, in other configuration lists, since the operation effectiveness is the same, it abbreviates the detailed explanation to the above-mentioned gestalt of the 1st operation.

[0035] Drawing 6 shows the gestalt of operation of the 3rd of this invention. As compared with the gestalt of the 1st operation shown in drawing 3 , the sense of the front flesh side of the wedge glass plate 23 is opposite. Thus, even if reverse, the same operation effectiveness as the gestalt of the 1st operation is acquired. And it is easy to be natural even if it communalizes the optical multiplexing spectral separation filter 22 and the wedge glass plate 23 with this gestalt as well as the gestalt of the 2nd operation.

[0036] Drawing 7 shows the gestalt of operation of the 4th of this invention. As compared with the gestalt of the 3rd operation shown in drawing 6 , the order of arrangement of the optical multiplexing spectral separation filter 22 and the wedge glass plate 23 differs. Thus, although optical arrangement relation can be suitably set up according to the property and gestalt of each part article and the target optical path can be realized, the concrete configuration is not uniform.

[0037] Drawing 8 shows the gestalt of operation of the 5th of this invention. The gestalt of this operation is arranging the optical isolator 24 between the wedge glass plate 23 and a collimate lens 12 on the basis of the configuration of the gestalt of the 3rd operation shown in drawing 6 . Thereby, optical-isolator ability is attached to an optical multiplexing splitter, and added value increases. Thus, it is free to add the optic and optical element of a required function in a module according to the concrete use purpose.

[0038] Drawing 9 shows the gestalt of operation of the 6th of this invention. This is the module of four ports, and 1st 2 heart ferrule 20 which has two parallel optical fiber core wires 41a and 42a as a fundamental module layout, and 2nd 2 heart ferrule 30 which similarly has two parallel optical fiber core wires 43a and 44a were arranged by the same axle on the module main shaft Ms which makes one straight line, the apical surface of both the ferrules 20 and 30 set predetermined spacing, and it has countered. Each optical fiber core wires 41a, 42a, 43a, and 44a are connected with optical fibers 41, 42,

43, and 44, respectively. Two optical fibers 41 and 42 are pulled out in parallel from the edge of 2 heart ferrule 20, and two more optical fibers 43 and 44 are pulled out in parallel from the edge of 2 heart ferrule 30.

[0039] Moreover, in the spacing part of the apical surface of both the ferrules 20 and 30, on said module main shaft Ms, the optical multiplexing spectral separation filters 22 and 32 and the wedge glass plates 23 and 33 which intervene between the collimate lens 21 which counters the apical surface of 2 heart ferrule 20, the collimate lens 31 which counters the apical surface of 2 heart ferrule 30, and two collimate lenses 21 and 31 arrange in serial, and are arranged.

[0040] And one optical fiber core wire 41a of 2 heart ferrule 20 and one optical fiber core wire 43a of 2 heart ferrule 30 carry out optical coupling on the transmitted light way of the optical multiplexing spectral separation filters 23 and 33. Moreover, two optical fiber core wires 41a and 42a of 2 heart ferrule 20 carry out optical coupling on the reflected light way of the optical multiplexing spectral separation filter 22. Furthermore, two optical fiber core wires 43a and 44a of 2 heart ferrule 30 carry out optical coupling on the reflected light way of the optical multiplexing spectral separation filter 32. it is **** about such optical arrangement relation -- it is carrying out.

[0041] Also in the gestalt of this operation, in 2 heart ferrule 20, collimate lens 21, optical multiplexing spectral separation filter 22, wedge glass plate 23, wedge glass plate 33, optical multiplexing spectral separation filter 32, collimate lens 31, and 2 heart ferrule 30, on the module main shaft Ms which makes one straight line, it arranges to a serial, and is arranged, and the whole is built in one telescopic case (not shown) by this arrangement relation.

[0042] While two optical fibers 41 and 42 are pulled out in parallel from the end section of the telescopic case, two more optical fibers 43 and 44 are pulled out from the other end of a telescopic case. Since it becomes such a module gestalt, compared with the module gestalt of the conventional configuration, the appearance configuration of a case serves as telescopic [simple], and can make a dimension small sharply conventionally.

[0043] And as mentioned above, this description is having realized by having adopted the configuration which arranges the proper wedge glass plates 23 and 33 into the optical path which ties collimate lenses 21 and 31, and bends an optical path appropriately. Each optic (2 heart ferrule 20, collimate lens 21, optical multiplexing spectral separation filter 22, wedge glass plate 23, wedge glass plate 33, optical multiplexing spectral separation filter 32, collimate lens 31, and 2 heart ferrule 30) can be put in order and arranged to the serial on the module main shaft Ms which makes one straight line by using appropriately the optical-path bending effectiveness of the wedge glass plates 23 and 33.

[0044] Furthermore, as shown in drawing 10 , also by the type of the module of four ports, by forming dielectric multilayers on the front face of the wedge glass plates 23 and 33, the optical multiplexing spectral separation filters 22 and 32 can be formed, and, of course, the unified configuration can also be taken.

[0045] With the above-mentioned gestalt of each operation, although the configuration of a wedge glass plate was all piece trapezoidal shape, if this invention is not restricted to this and an optical path is bent appropriately, the configuration will not be asked. If an example is shown, as it **, for example to drawing 11 , it can consider as the shape of a triangle. In this case, it is [0046] when the vertical angle of wedge glass plate 23' is made into (A+B).

[Equation 2]

$$\sin(\theta + B) = n \cdot \sin(A + B - \sin^{-1}(\sin A / n))$$

What is necessary is just to set up each include angle so that unrelated relation may be realized.

[0047]

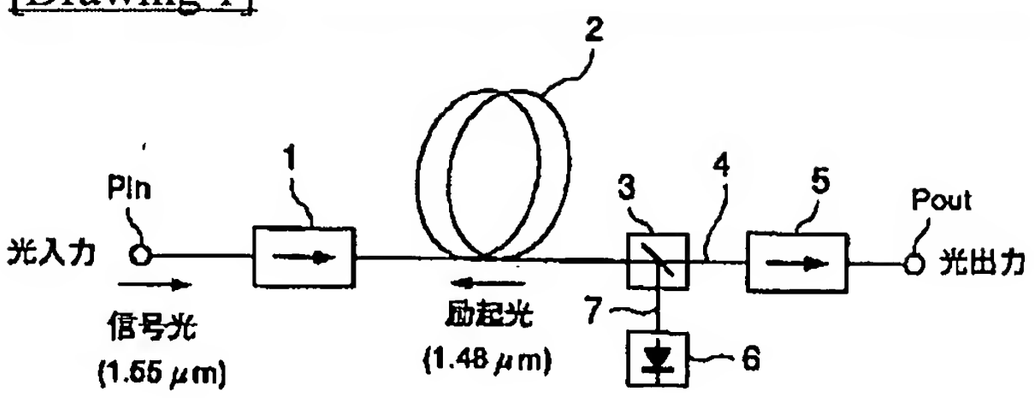
[Effect of the Invention] As explained to the detail above, by the optical circuit module of this invention, most 2 heart ferrule, the 1st collimate lens, an optical multiplexing spectral separation filter, a wedge glass plate, 2nd collimate lenses, 1 hearts, or 2 heart ferrules are arranged in in the shape of same straight line, and are arranged, and the whole is built in one telescopic case with this arrangement relation. And while two optical fibers are pulled out in parallel from the end section of the telescopic

case, 1 or two optical fibers 4 are pulled out from the other end of a telescopic case.
[0048] Since it becomes such a module gestalt, compared with the module gestalt of the conventional configuration, the appearance configuration of a case serves as telescopic [simple], and can make a dimension small sharply conventionally. Moreover, management of 3 or four optical fibers in the case of mounting is easy, and can make a mounting tooth space very small. Moreover, since two optical fiber core wires by which endocyst is carried out to 2 heart ferrule are approaching very much, it can respond with a common collimate lens to the two core wires. This also contributes to the miniaturization of a module case.
[0049] And since both ferrules can be arranged to the shape of same straight line, and parallel by having formed the wedge plate, include-angle adjustment at the time of attachment by the case can be performed easily.

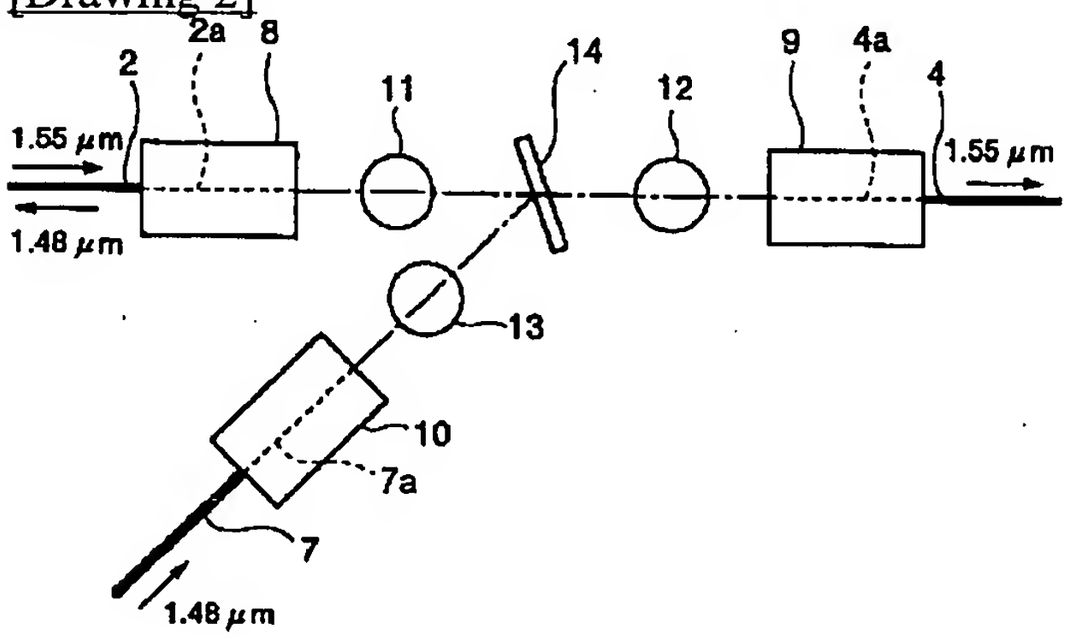
[Translation done.]

DRAWINGS

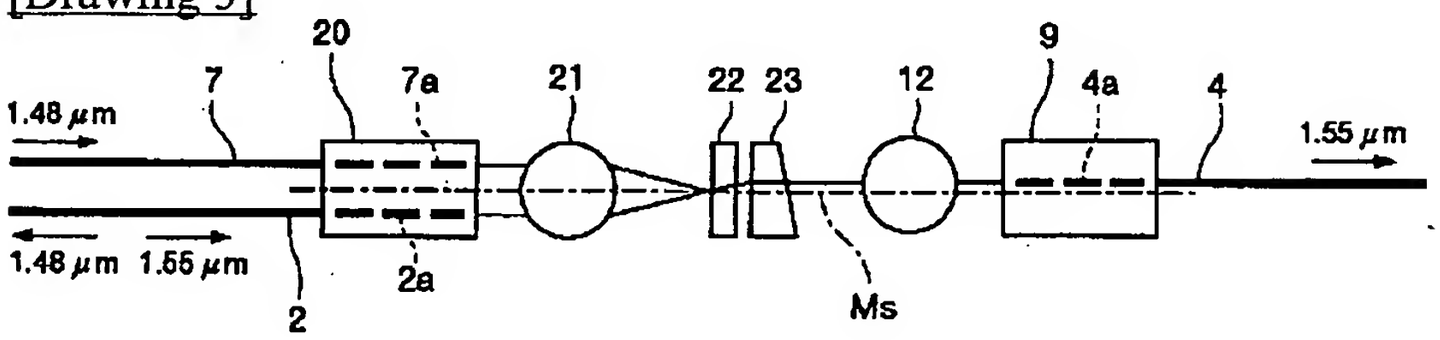
[Drawing 1]



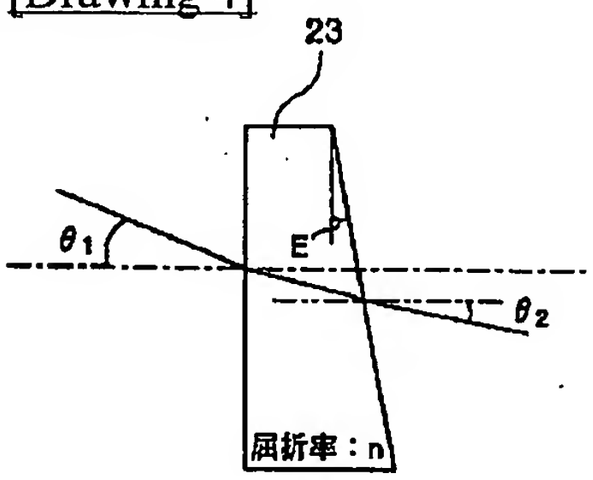
[Drawing 2]



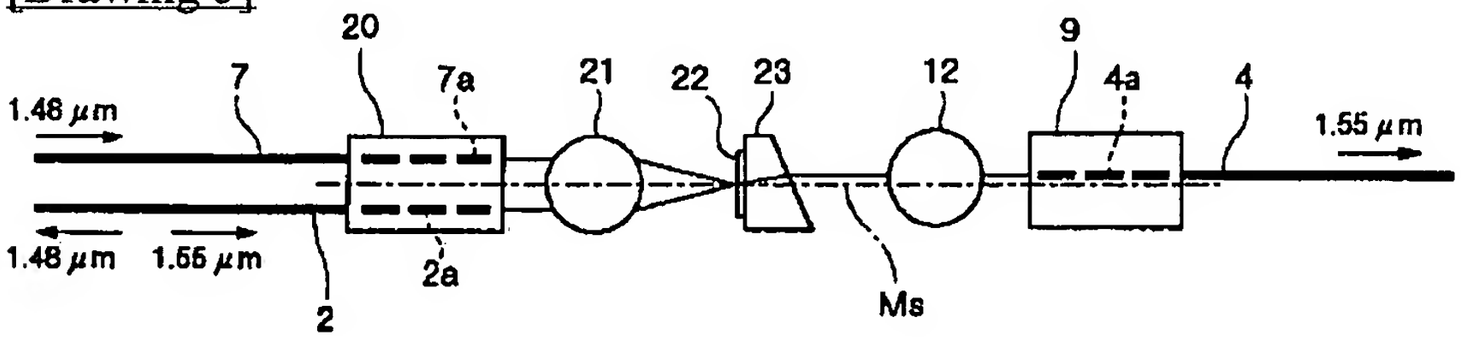
[Drawing 3]



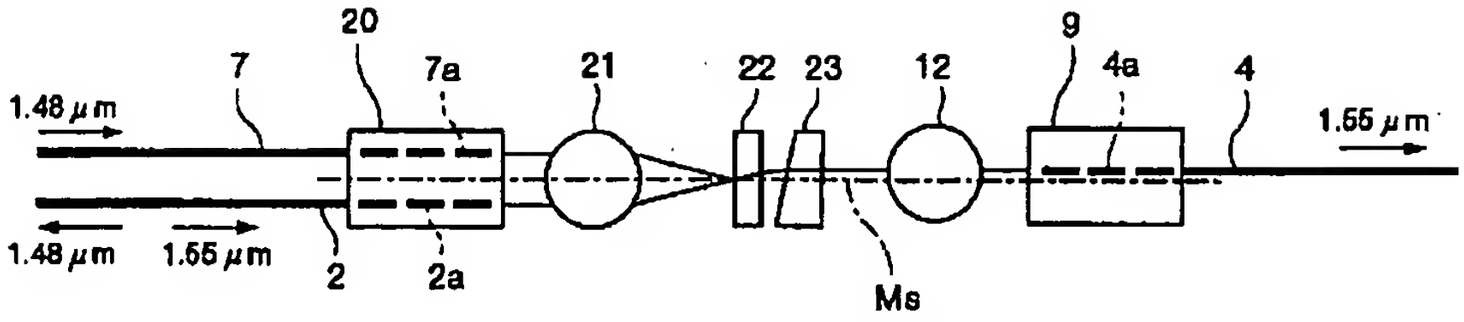
[Drawing 4]



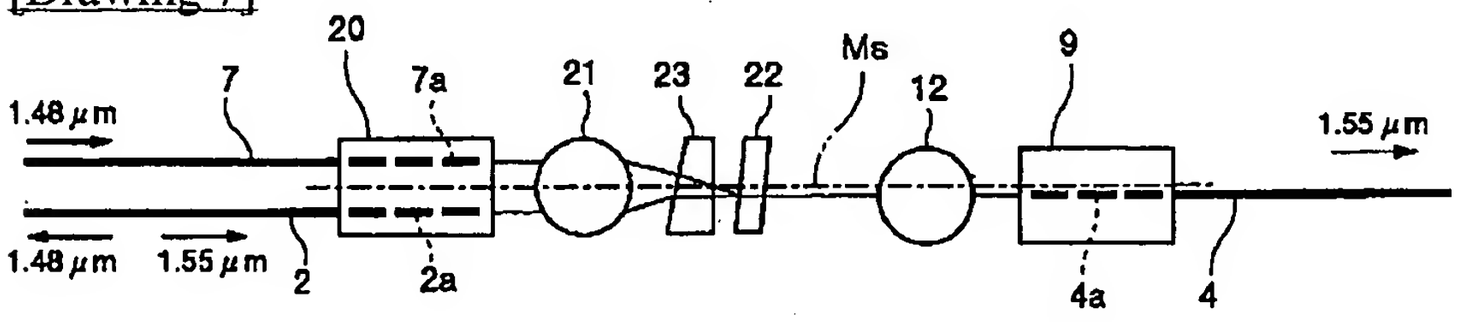
[Drawing 5]



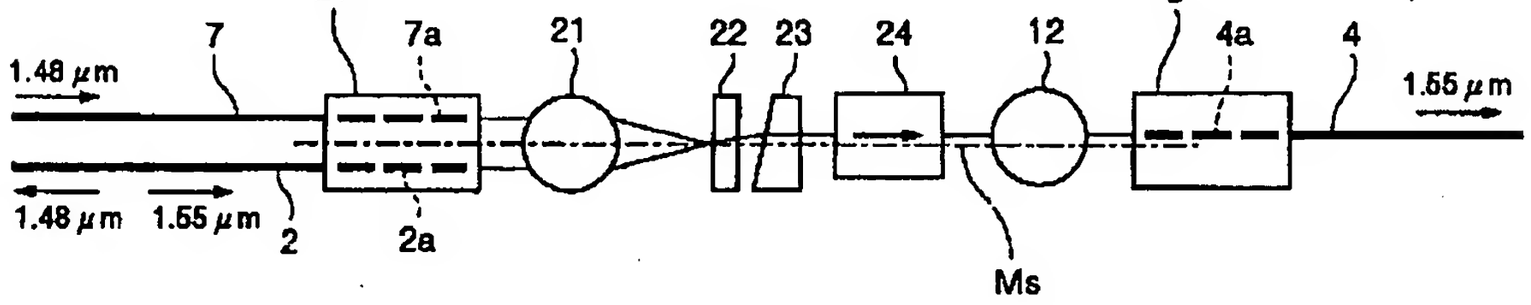
[Drawing 6]



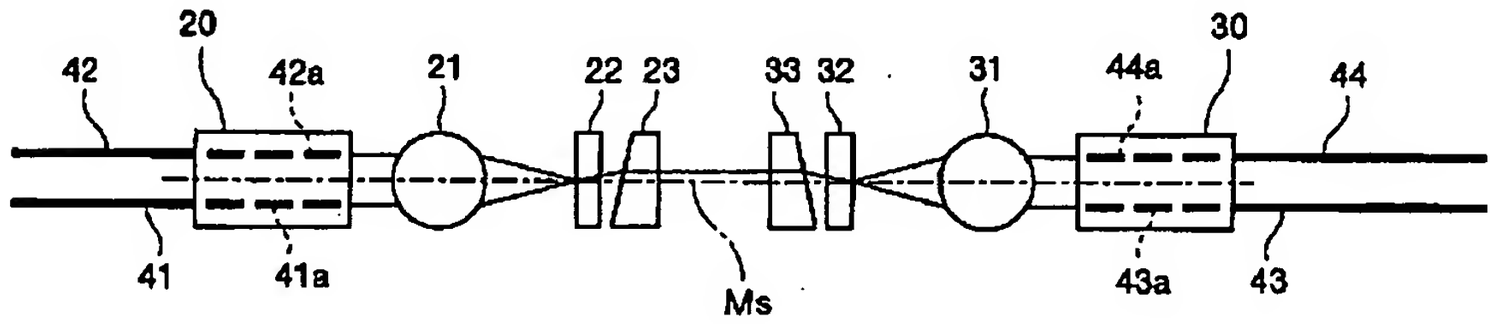
[Drawing 7]



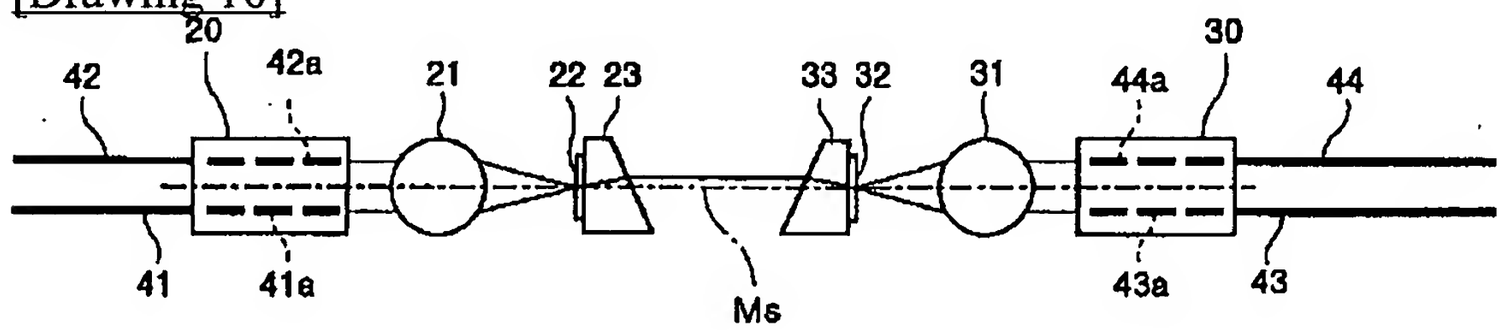
[Drawing 8]



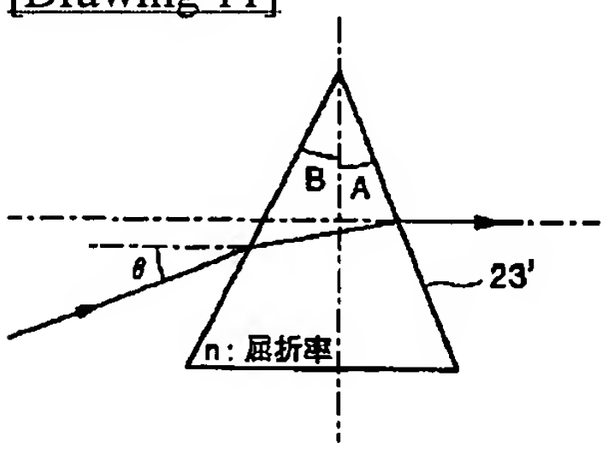
[Drawing 9]



[Drawing 10]



[Drawing 11]



[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] 2 heart ferrule which has the core wire (2a, 7a) of two parallel optical fibers (2 7) (20), 1 heart ferrule (9) which has the core wire (4a) of one optical fiber (4) The 1st collimate lens which it was mostly arranged by the same axle on the module main shaft (Ms) which makes one straight line, and the apical surface of said both ferrules set predetermined spacing, has countered, and counters the apical surface of said 2 heart ferrule (20) (21), The 2nd collimate lens which counters the apical surface of said 1 heart ferrule (9) (12), The optical multiplexing spectral separation filter (22) and wedge plate (23) which intervene between said 1st and 2nd collimate lenses In the spacing part of the apical surface of said both ferrules, on said module main shaft (Ms), arrange in serial and it is arranged. The core wire (4a) of said 1 heart ferrule (9) and one core wire (2a) of said 2 heart ferrule (20) carry out optical coupling on the transmitted light way of said optical multiplexing spectral separation filter (22). The optical circuit module characterized by two core wires (2a, 7a) of said 2 heart ferrule (20) carrying out optical coupling on the reflected light way of said optical multiplexing spectral separation filter (22).
[Claim 2] 1st 2 heart ferrule which has the core wire (41a, 42a) of two parallel optical fibers (41 42) (20), 2nd 2 heart ferrule (30) which similarly has the core wire (43a, 44a) of two parallel optical fibers (43 44) The 1st collimate lens which it was mostly arranged by the same axle on the module main shaft (Ms) which makes one straight line, and the apical surface of both ferrules set predetermined spacing, has countered, and counters the apical surface of 1st 2 heart ferrule (20) (21), The 2nd collimate lens which counters the apical surface of 2nd 2 heart ferrule (31), The optical multiplexing spectral separation filter (22 32) and wedge plate (23 33) which intervene between the 1st and 2nd collimate lenses In the spacing part of the apical surface of said both ferrules, on said module main shaft (Ms), arrange in serial and it is arranged. One core wire (41a) of said 1st 2 heart ferrule (20) and one core wire (43a) of said 2nd 2 heart ferrule (30) carry out optical coupling on the transmitted light way of said optical multiplexing spectral separation filter. The optical circuit module characterized by two core wires each of said 1st and 2nd 2 heart ferrules carrying out optical coupling on the reflected light way of said optical multiplexing spectral separation filter, respectively.
[Claim 3] The optical circuit module according to claim 1 or 2 characterized by forming the dielectric multilayers as said optical multiplexing spectral separation filter (22) in the front face of said wedge plate (23).

[Translation done.]